EYE ON THE SKY

National Weather Service
Louisville, Kentucky

Phone: **502-969-8842** ***Fax*: 502-968-5663**

Web Site: **www.crh.noaa.gov/lmk**

E-mail: **w-lmk.webmaster@noaa.gov**

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A Newsletter for Emergency Managers, Core Storm Spotters, Media, and Public Officials in Central Kentucky and South-Central Indiana

Comments and suggestions are always welcome. Your feedback is very important to us!

Please contact us by telephone, e-mail, or mail at

National Weather Service
6201 Theiler Lane
Louisville, Kentucky 40229

This publication also is available on-line at **www.crh.noaa.gov/lmk/newsletter**

Chief Editors For This Issue:
Van DeWald / Ted Funk

Changing of the Guard

As with everything in life, business and management change. During the summer, our former Meteorologist in Charge (MIC), Mr. Mike Matthews, transferred to a new position at National Weather Service Headquarters in Washington D.C. In the interim, Mr. Ted Funk, Science and Operations Officer at NWS Louisville, has been the Acting MIC and is responsible for local management decisions within our office.

Ms. Kim Bailey, the current MIC at NWS Missoula, Montana, has been selected as the new MIC at NWS Louisville. Kim started her NWS career in 1990 in Duluth, Minnesota, and then spent several years as the Warning Coordination Meteorologist in Glasgow, Montana before becoming the MIC at Missoula. Kim is expected to assume her duties at Louisville on or around October 15.

Daily Hazardous Weather Outlook Begins October 1

by Ted Funk, Acting MIC / Science and Operations Officer

On Tuesday, October 1, 2002, NWS Weather Forecast Offices (WFOs) will begin issuing daily Hazardous Weather Outlooks (HWOs) to emergency managers, public officials, the media, and the general public. These outlooks will serve as alerts for expected significant weather that potentially could threaten life or property. NWS offices (including Louisville) have long issued Special Weather Statements (SPSs), as needed, for certain weather phenomena, but this fall will mark the onset of HWOs as a nationwide standardized, stand-alone Hazardous Weather Outlook product.

Customers who wish to receive this outlook must add the communications identifier for NWS Louisville (FLUS43 KLMK and HWOLMK) to their databases. The product will be issued daily in the early morning (between 5 and 7 am eastern time), then updated as needed thereafter. It will concentrate on weather conditions during the first 24 hours, but also will cite potential hazards several days in advance, as warranted.

When hazardous weather threatens, the HWO will define the hazard, area affected, and timing, as well as a supportive synopsis of expected weather conditions. In spring and summer, the HWO will address risks associated with thunderstorms (including Storm Prediction Center severe weather outlooks), heavy rain, flooding, and the heat. In winter, it will discuss the potential for snow, ice, heavy rain, and the cold. In benign weather, the HWO will state that no hazardous weather is expected.

Inside This Issue . . .

Consolidation of Wind Chill Products for the 2002-2003 Season

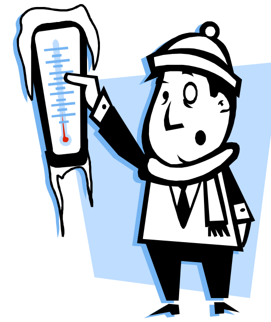
by Tony Sturey, Senior Forecaster

The National Weather Service (NWS) issues an array of forecast and warning products, many of which are built on a "graduated" or "tiered-type" system. In particular, several winter weather related products are categorized according to an Advisory-Warning two-tiered approach. Advisories are issued for those weather conditions deemed as an inconvenience to the public, while warnings are reserved for potentially life threatening situations. In general, this type of system is justified and essential in alerting the public to the hazards of winter weather.

Our nation has become an information-based society, dependent on accurate, clear, and concise data. As a result, the NWS periodically assesses its suite of products to ensure maximum customer usefulness and satisfaction. We continue to strive to reduce redundant products in an effort to streamline internal operations and product effectiveness, as well as to enhance external customer understanding and usage.

To this end, NWS Louisville will perform a test during the 2002-2003 winter season. We will consolidate the Wind Chill Advisory and Wind Chill Warning two-tiered system into a single entity called Wind Chill Warning.

NWS offices have determined fixed wind chill values that supposedly produce an inconvenience (Advisory) and serious threat (Warning) to the public. While colder wind chill temperatures will lead to more rapid frostbite on exposed flesh, the effective thresholds for an advisory and warning are somewhat arbitrary. In addition, the tiered approach can create ambiguity to the public. Does a person react or dress differently when there is a wind chill advisory versus warning in the forecast headline? Not likely. Let's face it, when it's cold, it's cold! A person will prepare for the cold no matter what the wind chill or headline.



Furthermore, a single product will be advantageous to the media, as supported from feedback from local TV meteorologists.

The bottom line for the upcoming test is this: When wind chill indices are predicted to be -10°F or colder with a minimum 10 mph wind across central Kentucky and south-central Indiana, NWS Louisville will issue a Wind Chill Warning. Within the body of the Warning statement, exact values expected, associated danger to the public, and recommended precautions will be specified. The table below provides a few examples of air temperature and wind values that would prompt a wind chill warning.

Temp (°F)	Wind Speed (mph)	Wind Chill (°F)
10°	25	-11°
5°	10	-10°
0°	10	-16°
-5°	10	-22°

In summary, we feel that the reduction from a two-tiered system for wind chill to a single product is a proactive decision that will offer simplicity, common sense, and streamline information, while retaining full product integrity in our efforts to increase public awareness and protect life and property during threatening winter weather. The test will be evaluated upon its completion.

New Cooperative Observer for Cumberland County, Kentucky

by Larry Dattilo, Data Acquisition Program Manager

In August, a new cooperative observing station was established in Kettle, located in Cumberland County, Kentucky just north of Dale Hollow Lake. Daily high and low temperatures and precipitation will be available from Kettle.

Our newest observer is Ms. Carol Merrill who has an intense interest in weather. Her interest began in fourth grade when the family barn was struck and destroyed by lightning. As she grew up, Carol spent many days at the local fire tower learning to take weather reports and to site fires. As a grown woman, Ms. Merrill depended upon the weather on the family farm to raise a garden and cut hey. Later, Carol and her husband drove tractor trailers and depended on the weather when driving across the country.

Now, Carol and her husband are raising their granddaughter Virginia, a second grader, and are teaching her how to take weather observations. Carol states, "The Coop program is a great science project. This also helps her with math, decimals, and fractions."

We thank Ms. Merrill and Virginia for taking an interest in the nation's climatology program and we welcome them to our weather family.

Severe Weather in the Fall

by Norm Reitmeyer, Warning Coordination Meteorologist

Typically as fall arrives, most people are pondering what kind of winter is in store. The Farmer's Almanac may announce their outlook for winter, while the National Weather Service will issue their official scientific expectations for the cold season in mid September.

But what about severe weather? Of course, April through June is the main severe weather season in the Ohio Valley, and the preparedness campaign occurs each year in March. However, it is important to remember that severe weather can occur at any time of year, including the fall. In fact, the last couple of autumns each contained significant severe weather events.

On November 9, 2000, severe thunderstorms raked central Kentucky and south-central Indiana. Five tornadoes were confirmed across central Kentucky, and considerable structural damage and downed trees and power lines were reported from both tornadoes and straight-line winds.

On October 24, 2001, severe thunderstorms again impacted much of central Kentucky and south-central Indiana. Much of the damage was in the form of downed trees and power lines, but large hail also was observed in a few areas.

It is a good idea in the fall and throughout the year to remember severe weather safety rules practiced and used in the spring. Have a plan of action. Know how to receive critical information, know when to act, and know what to do when severe weather threatens your area. A good rule of thumb is that when storms approach, go inside. You will be protected from lightning and will be able to take better cover if a storm turns severe. In a severe storm, stay away from windows and find shelter in a small interior room or closet.

Frost on the Pumpkin

by Van DeWald, Forecaster

If the pumpkins are ready for harvest, the frost upon them can't be far behind. The official end of the growing season for this region is the last Sunday in October, or the day we switch back to standard time. The average period for the first occurrence of frost is late October, but may be as early as the first week in October, or as late as November.

NWS Louisville once again will issue frost and freeze advisories, as needed, prior to the end of the growing season to advise you when plants and flowers need protection.

A *Frost Advisory* will be issued when the temperature of objects such as cars, trees, roofs, the ground, etc., is expected to fall near or below 32°F. If the frost period is severe enough, it is a "killing frost," which often ends the growing season.

A *Freeze Advisory* will be issued when the air temperature at 5 feet above the ground is expected to be 32°F or below over a widespread area for a significant amount of time. A freeze may or may not be accompanied by frost depending on wind speed. If temperatures are cold enough, it is labeled a "killing freeze," which will kill all but the hardiest crops.

Here are some tips to protect your plants from frost or freeze:

- Bring tender vegetation indoors if possible to protect them from the cold.
- Water your garden thoroughly before nightfall. Soil moisture released into the air around your plants overnight may keep the air slightly warmer.
- Use an electric fan to circulate air around your plants to prevent frost from forming on them.
- Cover your plants. To do so, create a tent with stakes placed around your plants, and newspapers, cardboard, plastic tarps, bed sheeting, or any other lightweight material draped over the stakes. If you cannot make a tent, then lay a lightweight material over the plants. This helps to slow the loss of heat from your plants. Remove the covering in the morning after the sun has melted the frost.

Radiation Fog: Formation, Maintenance, and Dissipation

The Science Corner

by Ted Funk
Acting MIC / Science and Operations Officer

Fog is a common occurrence across the Ohio Valley, including central Kentucky and south-central Indiana. Under certain atmospheric conditions, fog especially is common in valleys, low-lying areas, and near streams and rivers. In this issue, we look at factors that affect the formation, maintenance, and dissipation of *radiation fog*, a nighttime and early morning phenomenon.

Atmospheric Conditions

Certain atmospheric conditions must exist to generate radiation fog. In low levels (near the surface), key ingredients include moisture, rapid cooling, and calm or light winds. High pressure centers can create favorable conditions for radiation fog by suppressing surface winds and drying the air aloft through subsidence. Dry air (lack of clouds) aloft enhances radiative cooling at the surface.

Radiation fog is very unlikely to form unless there is sufficient moisture in the near surface (boundary) layer. Such moisture may be transported into an area, be derived through daytime evaporation from surface sources such as wetlands or wet soil, or pre-exist in low levels.

As night falls, clear, dry conditions above the boundary layer expedites cooling at and near the surface. On such nights, as much as 20-30 percent of the longwave radiation emitted by the earth escapes to space. Cloud cover absorbs more of the emitted radiation, thus inhibiting near surface cooling. Calm or light winds also maximize low-level radiative cooling, as turbulent mixing is minimized.

Formation

As earth's energy escapes, the ground cools rapidly which induces cooling of the lowest few meters of the atmosphere, creating a shallow surface-based *inversion*. If there is enough water vapor (moisture) in the air and enough cooling at the surface, the low-level air eventually becomes saturated (relative humidity = 100 percent). As cooling continues, water vapor near the surface begins to condense onto objects as dew or deposit itself as frost. Further cooling causes excess water vapor in the saturated layer to begin condensing into fog droplets.

A low-level *inversion* is present where the temperature in an atmospheric layer remains constant or increases with height (normally temperatures decrease with height in the troposphere). Inversions are common in the early morning near the ground (whether or not fog is present) and in low levels along and ahead of warm fronts.

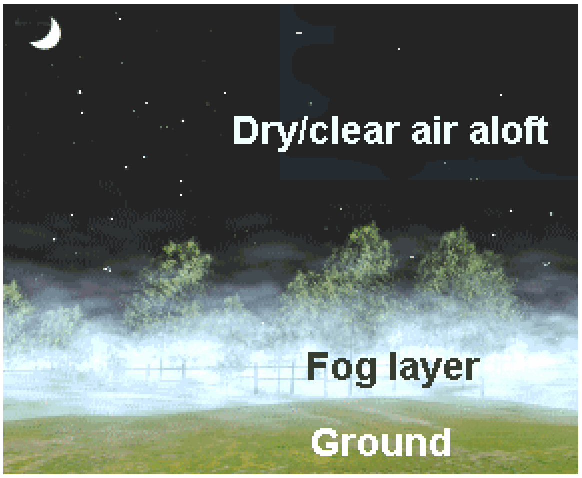
Different surfaces cool at different rates, depending on the surface type and thermal conductivity beneath the surface. Bare soil, a highly conductive surface, cools slowly at night since heat conducted from beneath the ground to the surface slows the radiative cooling process of the surface air. In contrast, grass or turf is a lower conductive surface which allows air in contact with it to cool and reach saturation faster. In addition, wet soil heats slower than dry soil during the day and cools quicker at night. Moreover, a significant portion of solar energy absorbed by wet soil contributes to increased low-level moisture via evaporation. This facilitates fog formation at night.

Surface snow cover also can promote radiation fog. Snow absorbs much less solar radiation than other surfaces, and a part of the absorbed energy is used for melting, resulting in less heating on the afternoon prior to fog formation. Snow cover also insulates the ground at night, limiting the upward conduction of heat from beneath the snow. Finally, nighttime radiative cooling occurs faster over snow cover than over soil or vegetative surfaces. These effects allow the lowest few meters of the atmosphere to reach saturation faster over snow-covered areas at night. However, snow cover also can inhibit fog if low-level moisture is shallow. In these cases, rapid cooling can cause frost to grow at the expense of fog droplets and deplete the boundary layer of the excess moisture it needs to form fog.

Radiation Fog: Formation, Maintenance, and Dissipation (continued)

Frozen ground, even without snow cover, also can favor radiation fog development. The frozen surface can seal the sub-soil layer, thus limiting heat absorption during the days, and quickening radiative cooling after dark.

Maintenance



As cooling continues, the fog depth can reach several meters, which is deep enough to begin to absorb and re-emit radiation from the earth. The fog blankets the lower levels, restricting radiative heat loss and slowing the rate of cooling at the surface. At the top of the fog layer, radiative cooling replenishes the supply of droplets through condensation as the droplets settle downward. This process tends to strengthen the inversion and deepen the fog despite evaporation just above the moist layer. The top of the fog and inversion layer normally are marked by the level where winds are strong enough to produce turbulent mixing which facilitates evaporation in some of the dry air aloft.

During the daytime, the introduction of mid- and upper-level clouds can help maintain the radiation fog layer. These clouds reduce the solar radiation received at the ground, preventing warming at the surface and maintaining a higher relative humidity in the lower portions of the fog layer.

Dissipation

During dissipation, the depth, areal coverage, and intensity of the fog diminishes. The duration of this phase can vary from less than an hour to half a day. Generally, the dissipation phase lasts for a few hours, since most fog is relatively shallow and short-lived. In protected mountain valleys, however, a significant radiation fog could take longer than a day to dissipate under certain conditions. The season also influences the length of dissipation through such factors as sun angle, average wind speed, snow cover, ground moisture, and vegetation.

As daytime progresses, shortwave radiant energy from the sun gradually is absorbed by the ground, despite the intervening layer of fog. As the ground slowly warms, it heats a thin layer of air in contact with the surface through conduction. This heat then initiates weak convective mixing, which begins to warm the lowest part of the fog layer. As a result, the relative humidity in this layer begins to decrease, which eventually leads to evaporation of the existing fog droplets. As the fog thins, the warming process accelerates, allowing more solar radiation to reach the ground. This causes the base of the fog to lift at a rate of up to several hundred feet per hour. In winter, snow cover and frozen ground slows near-surface heat transfer resulting in a longer dissipation period.

The onset of significant low-level winds can cause fog to dissipate both near the surface and at the fog top. Near the surface, winds cause mixing of the surface-warmed air with the fog above. At the fog top, winds entrain warmer, drier air from aloft into the fog. Both processes promote evaporation of fog droplets and improved visibility. Cold advection above the fog layer also can dissipate fog by weakening the fog top inversion, which enhances mixing processes.

National Centers For Environmental Prediction

The National Centers for Environmental Prediction (NCEP), an arm of the National Weather Service, is comprised of eight distinct Centers and the Office of the Director. NCEP is a critical national resource in national and global weather prediction. It is the starting point for nearly all weather forecasts in the United States. NCEP provides a wide variety of national and international weather guidance products to National Weather Service field offices, government agencies, emergency managers, private sector meteorologists, and meteorological organizations and societies throughout the world. Their website is www.ncep.noaa.gov.

List of Centers

- Aviation Weather Center
- Climate Prediction Center
- Environmental Modeling Center
- Hydrometeorological Prediction Center
- Marine Prediction Center
- Space Environment Center
- Storm Prediction Center
- Tropical Prediction Center

NWS Incident Meteorologists Assist Fire Fighters

by Joe Ammerman, Senior Forecaster

Wild land fires have been in the news this summer, first with the large fires in Colorado and Arizona and now with fires in Oregon. This season has been particular active with much of the western United States in extreme drought conditions from below normal rainfall for the last 3 to 4 years.

Most of the fires are ignited by lightning strikes but some are started by humans. Once these wildfires are identified, small groups of fire fighters called "hotshot" crews and "smoke jumpers" quickly are activated and sent to the fire. Many times these teams are successful and the fire is extinguished within a day or two. Sometimes, if fuels are thick and weather conditions are right, the fire quickly spreads and cannot easily be put out. Once a fire increases to more than 10,000 acres in size, large numbers of fire fighters are brought to the scene. A base camp is established usually in a small town. Sometimes as many as 3,000 fire fighters will live in the camp. In addition to the fire fighters, support personnel are brought in. There is a logistics section, operations section, transportation section, personnel section, supplies section, and a planning section. The planning section determines how the fire will be fought given the available resources, topography, and expected weather conditions. One of the biggest unknowns is weather conditions.

Therefore, the National Weather Service provides specially trained forecasters, called Incident Meteorologists (IMETs), to assist fire fighters. An IMET is sent to the base camp where he/she sets up a mobile weather office. The office consists of a satellite dish and laptop computer, along with other various items. With this equipment, the meteorologist is able to establish an observation network and provide on-site weather forecasts to fire fighters.

Generally, an IMET will remain on a fire from 10 to 14 days. If the fire persists past this time, another forecaster will be deployed to the fire to take over. While in fire camp, the forecaster sleeps in a tent, eats with the fire fighters, and bathes in a portable shower truck.

NWS Louisville has one of these specially trained IMET forecasters (Joe Ammerman). Over the last 10 years, he has been deployed to more than 30 fires ranging from Long Island, New York to the Pacific Coastal Range Mountains just south of San Francisco. This year, he was deployed to 2 fires, including southern Arizona along the Mexican border in June, and central Idaho in August to help with fires started by lightning.

NOAA Weather Radio Update

by Chris Smallcomb, Forecaster

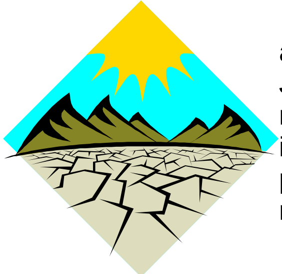
The implementation of new computer voices on NOAA Weather Radio (NWR) has been progressing steadily over the summer. “Craig” and “Donna” now announce a number of our products, including the local forecast and hourly weather roundup. These two will be joined by a third voice, “Tom,” in the near future. Once further improvements are made to the voice quality and local place name pronunciations, we intend to begin broadcasting warnings, watches, and other special statements with Craig, Donna, and perhaps Tom.

Several informative new products are being broadcast on NWR in our region. An 8 to 14 day temperature and precipitation outlook is on the air from around 5 pm to 8 pm each day. Also, a daily forecast of the ultraviolet (UV) index is broadcast during the early and mid morning hours. Moreover, in development is an air pollution outlook for the Louisville metro area, with data provided by the Jefferson County Air Pollution Control District. This will most likely be available for next summer's "air pollution season." Other ideas that have been considered include a Kentucky/Indiana daily weather roundup with observed highs, lows, and precipitation for a number of cities.

Finally, this autumn you will hear the ColorFall outlook as issued from the Kentucky Department of Tourism. This product will play periodically on NWR and will be updated weekly as information is posted on the Department's website.

Hydrologic / Drought Update

by Mike Callahan, Service Hydrologist



Drought conditions vary greatly across central Kentucky and south-central Indiana. Some areas have little or no drought while others are experiencing very dry conditions. June and July 2002 were drier than normal over east-central and south-central Kentucky, but above normal in parts of north-central Kentucky and south-central Indiana. This trend reversed itself in August. Lawns vary from very dry and brown to reasonably good shape, while some problems have been reported with crops. Meanwhile, streams are flowing at levels close to normal, the forest fire threat is not high, and most communities have adequate water supplies.

The lack of rain this summer has caused some locations to be below the normal annual total rainfall. Through August, Lexington and Bowling Green were about 4 inches and 1 inch below normal for the year, respectively, while Louisville was around 2 and one half inches above normal thanks to a wet spring. For the summer period of June, July, and August, both Louisville and Lexington were around 6 inches below normal, while Bowling Green was about 2 inches below normal. In fact, this August was the sixth driest on record in Louisville.

The measure we use for determining long-term drought, the Palmer Drought Severity Index, indicates that east-central Kentucky and south-central Indiana are in a moderate drought. However, central Kentucky remains in a mild drought, only because of above normal rainfall across southern Kentucky in August.

What can we expect for the fall? The latest prediction for the Ohio Valley calls for temperatures to average near normal. Precipitation is expected to be near normal in the western half of our region, but below normal in the eastern half. This is not good news if you live around Lexington, but conditions may be worse east of Kentucky. Therefore, drought conditions still will be a concern this fall, which historically is a relatively dry time of year.

Upcoming Amateur Radio Exercises

by Norm Reitmeyer, Warning Coordination Meteorologist

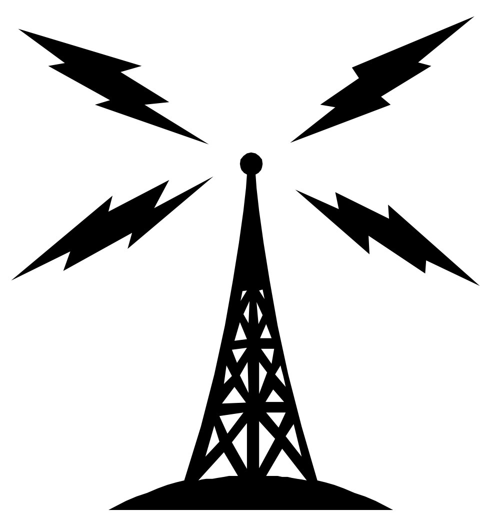
On October 5, 2002, the Kentucky Simulated Emergency Test (SET) will take place. This year's test will originate at NWS offices that serve Kentucky, and will focus on a simulated severe weather event. HAM radio operators at amateur radio stations within NWS offices will seek to reach local VHF/UHF spotter nets and individual amateur stations who are encouraged to use emergency power of some type for their operations.

There will be several **SET** objectives:

1. Encourage construction or implementation of emergency power capabilities for amateur radio stations across Kentucky.
2. Provide refresher training for NWS Net Control Station (NCS) operators and net participants.
3. Provide refresher training for amateurs on Skywarn net practices in their areas.
4. Evaluate the percentage of Kentucky's 120 counties covered by amateur radio.
5. Allow NWS offices to assess their amateur radio equipment's coverage into repeaters they service.
6. Increase awareness that severe storms can occur in the fall as well as in the spring.

The second event will be the 2002 Skywarn Recognition Day (SRD). SRD is the day amateur radio operators visit NWS offices and contact other operators around the world. The purpose is to recognize the contributions amateur radio operators make to NWS warning operations, and to strengthen the bonds between amateur radio operators and the NWS.

SRD will be held this year from 0000 UTC to 2400 UTC on December 7, 2002 (8 PM EST/7 PM CST Friday evening to 8 PM EST/7 PM CST Saturday evening). SRD is sponsored by the National Weather Service and the American Radio Relay League.



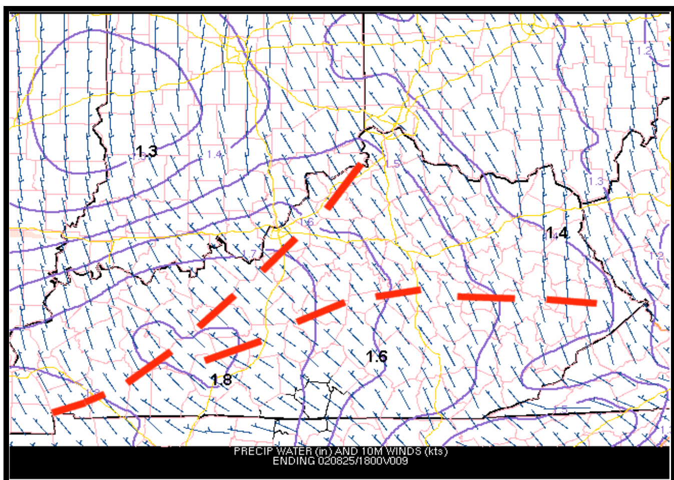
Mesoscale Modeling at NWS Louisville

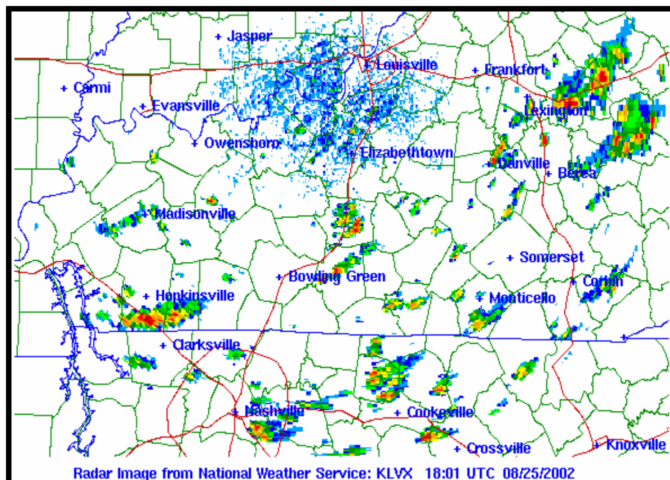
by Chris Smallcomb, Forecaster

The Louisville weather forecast office has been actively using output from a 10 km version of the Mesoscale Model Version 5 (MM5) since late spring. This model provides high-resolution forecasts of temperatures, winds, and many other atmospheric and convective parameters. This data has proven especially useful for radiational fog forecasting (see related article in this newsletter) and prediction of diurnal summertime thunderstorms.

MM5 low-level winds have been helpful in determining the likelihood of radiational fog. If predicted winds from 50-300 meters above ground are too strong late at night, then even with a clear sky, high humidity, and calm surface wind, significant fog usually will not form. The visibility may drop to around 2-3 miles, but not to one-half mile or less, which is a major concern for aviation purposes. Thus, MM5 output is useful in preparing our aviation terminal forecasts for Louisville International Airport, Lexington Bluegrass Field, and Bowling Green Airport.

To assist in summertime thunderstorm forecasting, the MM5 has revealed the development of small-scale pools of very high precipitable water (PW, i.e., a measure of total atmospheric moisture content) due to localized, but strong low-level moisture convergence. Below (left) is an example of a 9-hour MM5 forecast of precipitable water and surface winds, and a WSR-88D Doppler radar image (right) at the model forecast valid time, 1800 UTC (2:00 pm edt) on August 25, 2002.





Notice how thunderstorms were developing in a ridge axis of high PW values from Nashville and Hopkinsville northeast across Lexington and east-central Kentucky. Meanwhile, no thunderstorms were occurring over southern Indiana in an area of lower MM5 PW values.

Of course, areas of high moisture content are not the only ingredient necessary to force thunderstorm development. Zones of maximum atmospheric instability and small-scale lift (provided by a front, thunderstorm outflow boundary, mountainous terrain, etc.) also are required for storm initiation. In addition, model forecast data may not resolve all small-scale phenomena associated with the location, timing, and areal extent of summertime scattered thunderstorm development. This is where the MM5, in conjunction with observed data trends, has the potential for more accurate and refined forecasts due to its enhanced horizontal and vertical resolution versus other model output.

Improvements to our MM5 model in the next few months will include 1) assimilation of Kentucky Department of Transportation (DOT) road sensor data into the model analysis to test its effect on forecasts, and 2) creating graphics for the fall fire weather season and winter weather forecasting purposes.

If you have any questions about our mesoscale modeling efforts or numerical weather prediction (fancy phrase for computer forecast models) in general, feel free to contact me.

The National Weather Service provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy.

Climatological Calendar

Climatological Data: Summer 2002							
Location	**Month**	**Average Temperature**	**Departure From Normal**	**Total Precipi-tation**	**Departure From Normal**	**Highest Temp (Date)**	**Lowest Temp (Date)**
Louisville	Jun	75.1°	+0.9°	3.32”	-0.44”	92° (30th)	54° (7th/17th)
	Jul	79.1°	+0.7°	0.78”	-3.52”	94° (28th/29th)	64° (12th/14th)
	Aug	88.9°	+1.2°	0.96”	-2.45”	99° (4th)	58° (9th)
Lexington	Jun	74.5°	+2.3°	2.69”	-1.89”	94° (25th)	49° (17th)
	Jul	79.1°	+3.0°	1.76”	-3.05”	96° (4th)	62° (7th)
	Aug	89.1°	+3.3°	2.92”	-0.85”	99° (4th)	57° (7th/9th)
Bowling Green	Jun	75.7°	+1.3°	1.20”	-3.09”	94° (4th)	54° (18th)
	Jul	79.8°	+1.3°	3.57”	-0.97”	95° (5th)	61° (7th)
	Aug	89.9°	+2.4°	5.10”	+1.74”	98° (4th/5th)	56° (8th)

Normal High/Low Temperatures				
Location	**Sep 1**	**Oct 1**	**Nov 1**	**Dec 1**
Louisville	83/65	74/55	62/43	50/34
Lexington	82/62	73/52	60/41	49/33
Bowling Green	85/63	76/52	63/41	52/33

Outlook for Fall 2002

The 90-day outlook for September, October, and November 2002 calls for near normal temperatures, and below normal precipitation across the east half of the Ohio Valley. Despite forecasted near normal climatological conditions, daily weather can vary widely, with periods of unseasonably warm and cool temperatures, and episodes of heavy precipitation including thunderstorms.

Astronomical Calendar

Sunrise/Sunset						
	Louisville		**Lexington**		**Bowling Green**	
Date	**Sunrise**	**Sunset**	**Sunrise**	**Sunset**	**Sunrise**	**Sunset**
Sep 1	7:13 am edt	8:13 pm edt	7:08 am edt	8:08 pm edt	6:17 am cdt	7:14 pm cdt
Oct 1	7:39 am edt	7:26 pm edt	7:34 am edt	7:21 pm edt	6:41 am cdt	6:29 pm cdt
Nov 1	7:09 am est	5:44 pm est	7:04 am est	5:39 pm est	6:10 am cst	4:49 pm cst
Dec 1	7:41 am est	5:23 pm est	7:37 am est	5:19 pm est	6:40 am cst	4:29 pm cst

Times are given in est (Eastern Standard Time), edt (Eastern Daylight Time), cst (Central Standard Time), and cdt (Central Daylight Time), as appropriate.

Moon Phases			
New Moon	**First Quarter**	**Full Moon**	**Last Quarter**
Sep 6	Sep 13	Sep 21	Sep 29
Oct 6	Oct 13	Oct 21	Oct 29
Nov 4	Nov 11	Nov 19	Nov 27
Dec 4	Dec 11	Dec 19	Dec 26

Autumnal Equinox (Start of Fall):
September 23 at 12:56 am edt

Start of Standard Time:
Sunday, October 27, at 2:00 am local time
- (turn clocks back one hour)